DISCUSSION OF ISSUES PERTINENT TO RULEMAKING TO DESIGNATE FISCHER-TROPSCH DIESEL FUEL AS ALTERNATIVE FUEL UNDER SEC. 301(2) OF THE ENERGY POLICY ACT OF 1992

UNITED STATES DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

July 2002

DOE Contact: Linda Bluestein

TABLE of CONTENTS

I. INTRODUCTION

The Department of Energy (DOE) is undertaking a rulemaking to determine whether diesel fuels produced from natural gas[1] should be designated as alternative fuels under section 301(2) of the Energy Policy Act of 1992 (EPAct).

Sec. 301(2) of EPAct provides:

> *the term "alternative fuel" means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas, including liquid fuels domestically produced from natural gas[2]; liquified petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits;*[3]

Sec. 301(2) authorizes DOE to designate fuels as alternative fuels if DOE finds three criteria to be met: (1) that the fuel is substantially non-petroleum; (2) that it yields substantial energy security benefits; and (3) that it yields substantial environmental benefits. These criteria are separate and each must be met separately. If a fuel is substantially non-petroleum and yields substantial energy security benefits, for example, but does not offer any environmental benefits, it cannot be designated. DOE's interpretation of these criteria is discussed below. While DOE cannot designate a fuel unless it meets all three criteria, DOE believes that the statute gives DOE considerable discretion in interpreting the criteria and in determining whether a fuel should be designated. For example, fuels might offer substantial benefits in terms of one environmental medium but cause adverse impacts on another environmental medium; DOE can weigh the risks against the benefits and might decide not to designate the fuel. Thus, even if a fuel can be said to offer certain energy security and environmental benefits, DOE has considerable discretion not to designate it, considering a range of factors and looking at the overall effect.

Designation as an alternative fuel under sec. 301(2) has significance in terms of various other sections of EPAct. Section 501(a)(4) of EPAct requires certain alternative fuel providers to operate vehicles solely on alternative fuel when operating in areas where such fuels are available. EPAct requires various entities to acquire alternative fuel vehicles (AFVs), including federal fleets (sec. 303), alternative fuel providers (sec. 501), and state government fleets (sec. 507(o)). Designation of a fuel as an alternative

---

[1] "Fuels produced from natural gas," refers only to fuels produced from the processing of a natural gas stream. It does not include mere use of by-product streams such as natural gas liquids. DOE has previously pointed out that "natural gas liquids" are not classified as replacement fuel or alternative fuel (*Replacement Fuel and Alternative Fuel Vehicle Technical and Policy Analysis*, December 1999, Office of Transportation Technologies, DOE, p. 33, fn. 25).

[2] The phrase "*including liquid fuels domestically produced from natural gas*" was added in the FY 2000 Consoidated Appropriations Act (P.L. 106-554).

[3] DOE previously clarified that 100% "biodiesel" fuels made from plant materials such as soy, rapeseed, or cooking oils fall within the term "fuels (other than alcohols) made from biological materials." 61 *Fed. Reg.* 10629, March 14, 1996. DOE previously used its authority to designate additional fuels meeting the three sec. 301(2) criteria for certain blends of ethanol, methyltetra-hydrofuran, and gasoline ("P-Series Blends") to be alternative fuels. 64 *Fed. Reg.* 26822, May 17, 1999.

fuel under sec. 301(2) could affect the determination of what vehicles meet those requirements. Under Executive Order 13149 (65 *Fed. Reg.* 24607, April 26, 2000), federal fleets are directed to achieve a goal of over 50% alternative fuel use in their EPAct vehicles by the end of FY 2005; designation as an alternative fuel would qualify the fuel toward those requirements. Finally, sec. 502(b) of EPAct suggests a goal of alternative and replacement fuel use as 30% of U.S. light duty motor vehicle fuel use by 2010, with a variety of reporting and analysis requirements in other sections. Designation of an alternative fuel under sec. 301(2) would mean that use of the fuel would count toward the goal.

DOE's rulemaking will only affect implementation of the Energy Policy Act of 1992, as described in the preceding paragraph; it will not directly affect any other federal, state, or local fuel requirements in any way.

DOE is undertaking this rulemaking partly in response to three petitions received by DOE from Rentech, Inc., Mossgas, (Pty) Limited., and Syntroleum Corp. Each of these petitions requests designation of specific diesel fuels produced by variations of the Fischer-Tropsch (FT) process. The FT process involves conversion of a hydrocarbon feedstock (along with available carbon dioxide, air, and/or oxygen created for that purpose) to a "synthesis gas" consisting of streams of (1) hydrogen and (2) carbon monoxide. The synthesis gas is then reacted to a mixture of hydrocarbons, which can include a combination of liquids, gases, and solids. The hydrocarbon output typically undergoes some further processing, such as separation of various products and additional steps using off-the-shelf refining processes. DOE believes that any diesel fuel to be made from natural gas is likely to be made through a variation of the FT process and will refer to this subject throughout its discussion as Fischer-Tropsch diesel (FTD)[4]. An EPAct designation of natural gas based diesel fuel could, however, at least hypothetically, include such fuels made through other processes. ***DOE will consider how to define any such designation in this rulemaking and invites comment to this effect, including how FTD should be defined if a designation were ultimately limited to that process***.

For reasons explained below (see especially Section VIII), DOE is not inclined to define any designation of natural gas based diesel fuels in terms that would be proprietary to any or all of the three petitioning companies. Rather, DOE believes that any designation of such fuels should be made in terms of fuel and process parameters that will assure that the designation criteria of sec. 301(2) are met and will apply to such fuels and processes generically. DOE also believes that production processes utilizing the proprietary technologies of the three petitioners are sufficiently flexible to meet whatever specifications DOE may adopt. It may not be necessarily true, however, that all fuels using the petitioners' technologies will qualify under such a designation since DOE believes that FTD fuel quality is largely determined by plant-specific factors, operating conditions, and post-synthesis refining.

DOE understands that FTD can also be made from a variety of feedstocks, including coal, biomass, and petroleum bottoms. DOE's intention, however, is that this rulemaking be limited to FTD made from natural gas and landfill gas.[5] Determinations relating to the sec. 301(2) criteria could be different for

---

[4] The acronym FTD is used herein to refer to all diesel fuels made through variations of the Fischer-Tropsch process. In distinguishing between fuels made directly through the Fischer-Tropsch process and Mossgas's Fischer-Tropsch/Conversion of Olefins to Distillate process, we use the terms F-T and FT/COD.

[5] Sec. 301(2) lists "*coal derived liquid fuels*" as alternative fuels, which would include FTD fuels made wholly from coal. Similarly, FTD made wholly from biomass would presumably be covered by the sec. 301(2) term "*fuels (other than alcohol) derived from biological materials*." DOE has not made any determinations regarding specific processes as falling into these

fuels made from other feedstocks, including fuel impurities and plant emissions. DOE is not aware of an adequate body of data to make those determinations and believes that they would have to be considered in a separate rulemaking. DOE believes, on the other hand, that FTD made from landfill gas will be sufficiently similar to FTD from natural gas (and will likely be even more beneficial in reduction of greenhouse gas emissions) so that it can be included in a single rulemaking.

DOE's rulemaking must result in a regulation to be codified in the Code of Federal Regulations (10 CFR Part 490). DOE believes that the appropriate approach to such a regulation is for DOE to promulgate a definition of what diesel fuels from natural gas feedstocks will be included in the designation in terms of objective fuel properties and process limits that will assure that the EPAct sec. 301(2) criteria are met. As noted above, three petitions have been received by DOE each requesting a designation specific to that particular company. In a subsequent submission, however, Rentech, Inc., suggested that a set of objective standards be used as the basis for the designation. DOE believes that an objective designation would be more appropriate than individual proprietary designations.

As Rentech explained in its supplemental submission, "we are petitioning DOE for FTD as a whole to be classified as an 'alternative fuel' under EPAct. We believe that a specific fuel analysis for a batch of FTD under specific conditions being classified as an alternative fuel would be too specific and not serve the intent of EPAct to get alternative fuels adopted. Therefore, we would propose the following general specifications be adopted for FTD fuels." DOE agrees that specific fuel analyses for particular batches of FTD fuel are not necessarily representative of FTD processes in general nor necessarily representative of all production from the "proprietary processes" that produced them. DOE further believes that any designation of FTD fuels should be done in the form of a set or sets of fuel and process parameters.

Table 1. FTD Specifications Suggested by Rentech

Cetane	>60
Sulfur	<5 ppm
Aromatic wt.%	<0.05
Copper Strip Corrosion	1a
90% distillation	540 - 640° F
Viscosity @ 40^{O} C cST	1.9 - 4.1
Conradson Carbon on wt. %	<0.35
Ash wt. %	<0.001
Flash Point	>125° F
Heat of Combustion (Btu/lb. gross)	>18,000
Oxygen Content	<1%
Process Efficiency	<11.5 mm Btu/barrel
Lubricity (ASTM 6079 HFRR)	<675

The specifications suggested by Rentech are shown in Table 1.

At this time, DOE is not proposing specifically what parameters should be specified or what limits should be set, but some possible ranges of such limits are suggested in the pertinent sections below. These

categories. To do so would require only an interpretation rather than a rulemaking. Since DOE has not been presented with any specific process data for coal or biomass based FTD, it is not addressing that issue in this rulemaking.

analyses discuss various fuel parameters and their relationships to vehicle emissions, GHG emissions from both vehicles and production processes and options for limiting them, and possible process parameters relating to energy security.[6]

Based on an analysis by DOE's National Renewable Energy Laboratory (NREL), DOE believes that key fuel properties associated with FTD fuels are likely to result in tailpipe emissions reductions, particularly reductions of NO_x emissions. These emission reductions, assured through limits on the key fuel parameters, could provide a basis for a finding that FTD fuels offer substantial environmental benefits if greenhouse gas emissions are not increased substantially and some other concerns are satisfactorily addressed. DOE also believes that FTD fuels could offer energy security benefits, particularly in conjunction with process energy restrictions on the production facilities. At the same time, DOE is concerned about the lack of data identified to date (including that submitted by the petitioners) regarding a number of issues relating to a possible rulemaking to designate FTD fuels. DOE's analysis of the existing data is laid out in this discussion paper and in background papers available in the docket by NREL and by Argonne National Laboratory (ANL). ***DOE requests comment on these analyses and requests that any members of the public possessing additional data pertinent to the analyses, particularly on those issues for which a lack of data are noted below, submit such data to DOE for inclusion in the docket.***

II. SUBSTANTIALLY NON-PETROLEUM

DOE's intent at this time is to limit its rulemaking to neat FTD fuels made from natural gas and landfill gas. According to data submitted by the petitioners and other sources, as accepted in a report prepared by Michael Wang of Argonne National Laboratory for purposes of this rulemaking, FTD made from these sources is not expected to utilize any petroleum as feedstock and only minor amounts for process energy.[7] FTD production is highly exothermic. Plant processes will be largely self-sustaining based on capture of the process heat and utilization of tail gas hydrocarbons. To the extent that other fuel is needed, it will mostly be taken from the gas feedstock stream. Based on these expectations, which DOE believes to be reasonable, FTD is likely to be 96-100% non-petroleum, exclusive of any additives to be used with the fuel. Additives will be discussed below. Those additives that are petroleum based are expected to constitute a tiny fraction of the fuel, probably less than 1%. It seems clear, therefore, that FTD made from natural gas or landfill gas meets the EPAct criterion of being substantially non-petroleum.[8] [9]

---

[6] A number of the parameters proposed by Rentech are not addressed below specifically but would be included in the terms of any DOE designation of FTD by incorporation of ASTM D-975-02, as suggested below.

[7] "Assessment of Well-to-Wheel Energy Use and Greenhouse Gas Emissions of Fischer-Tropsch Diesel," Michael Wang, Center for Transportation Research, Argonne National Laboratory, prepared for Office of Technology Utilization, U.S. Department of Energy, December 6, 2001, Table 4, p. 12, Docket No. EE-RM-02-200-1B.

[8] Blends of FTD with conventional diesel could be "substantially non-petroleum." See the discussion of public comments on the Pure Energy Corporation petition for designation of P-Series fuels, 64 Fed. Reg. 26823. DOE does not intend to address such blends in this rulemaking because of the lack of data on the other benefits of such blends and because none of the petitioners have requested that such blends be designated.

[9] Mossgas includes in its petitions two fuels, RFD1 and RFD3 that contain 7% condensate from the natural gas wells dedicated to the Fischer-Tropsch production. Although Mossgas identifies these constituents as petroleum based, DOE is treating them as natural gas based for purposes of this rulemaking. This does not imply that DOE deems natural gas condensate generally to be non-petroleum.

III. SUBSTANTIAL ENERGY SECURITY BENEFITS

It should be noted that the very fact of being substantially non-petroleum provides some energy security benefit, which is most likely why it was included as a criterion. While petroleum makes up about 40% of total U.S. energy use[10], on-road transportation remains over 95% dependent on petroleum fuels.[11]

As the U.S. General Accounting Office (GAO) determined*: "In essence, the economic costs of oil price shocks depend largely upon the rise in the price of oil coupled with the nation's* ***dependence on oil consumption****, rather than the level of imports. As long as market forces prevail, the price of domestic and world oil will be the same and will rise and fall with changes in world oil market conditions*."[12] (Emphasis added.) In that sense, a fuel's non-petroleum nature could be more important than where it is produced.

In identifying energy security benefits as a separate criterion from being "substantially non-petroleum," however, EPAct clearly intended that DOE look beyond the fuel being non-petroleum; it recognized the possibility that a fuel could be non-petroleum and not offer such energy security benefits.

In the only prior sec. 301(2) designation DOE has made, DOE found that the candidate fuels offered substantial energy security benefits because they were at least 60% renewable and likely to be approximately 95% derived from domestic sources.[13] Natural gas derived FTD, by contrast, is derived 100% from fossil sources and is expected to be very predominantly foreign produced. (All of the 3 plants currently operating and twelve of the thirteen announced as in design or under serious consideration are foreign, though not all of these will necessarily be exporting to the U.S.)

In considering FTD's energy security benefits beyond its being "substantially" non- petroleum, DOE has identified four characteristics which, taken together, DOE believes suggest that it will have substantial energy security benefits:

natural gas based FTD's non-petroleum content is not just "substantial" but is nearly total (96-100% with process energy);
FTD will result in net displacement of petroleum;
FTD is readily producible from natural gas feedstock that is relatively abundant; and
FTD could be available from a wide geographic diversity of sources.

---

[10] *National Energy Policy*, Report of the National Energy Policy Development Group, May 2001, p. 1-10.

[11] *Replacement Fuel and Alternative Fuel Vehicle Technical and Policy Analysis*, U.S. DOE Office of Transportation Technologies, December 1999, p. 9.

[12] *ENERGY SECURITY, Evaluating U.S. Vulnerability to Oil Supply Disruptions and Options for Mitigating Their Effects*, GAO/RCED-97-6, December 1996, p. 3.

[13] 64 *Fed. Reg*. 26826, May 17, 1999.

Net Displacement of Petroleum

Use of FTD is likely to result in net displacement of petroleum because it is most likely to be made from gas feedstocks that either:

> will be produced specifically for that purpose (net new energy production); or
> are produced in association with petroleum production and would otherwise be reinjected into subterranean structures (net gain in non-petroleum energy).

Such feedstocks can be distinguished from existing sources of non-petroleum energy that are currently being put to beneficial uses and which, if diverted to alternative fuel use, would have to be replaced with other sources of energy, thus providing no net displacement of petroleum. In such cases, it would be unlikely that energy security benefits would accrue. FTD is unlikely to be made from such sources but will be made either from gas reserves or associated gas that would otherwise be reinjected.

Relative Abundance of Feedstock

The USGS "World Petroleum Assessment 2000" provides estimates of conventional[14] oil and gas reserves outside the United States, including remaining reserves in discovered fields, reserve growth and undiscovered reserves. The mean estimate for conventional oil reserves is 2,120 billion barrels, compared to 539 billion barrels of cumulative production. For natural gas the mean estimate of total reserves is 2,099 BBO equivalent, compared to cumulative production of 150 BBO equivalent. Another 324 BBO equivalent of natural gas liquids are also estimated. Gas use has been growing at approximately 3% per year, and EIA has predicted that gas use will grow from 95 quads in 2000 to 174 quads by 2020 even without any substantial switching of the transportation sector to natural gas based fuels.[15] This will reduce but not quite eliminate the difference in reserves/production ratios between oil (which has been growing at 2%) and gas.[16] Thus, even with gas use continuing to grow faster than petroleum, the U.S. and the world are expected to have longer supply horizons of conventional gas than petroleum for the foreseeable future. Moreover, some of these identified gas supplies might not otherwise be used, such as those from small "stranded" fields and gas associated with oil production that would otherwise be reinjected.

In addition to the conventional gas reserves referred to above, vast "unconventional" gas reserves exist and technology may be today on the margin of making some such sources economic. Gas hydrates, for example, in the U.S. alone have been estimated at 200,000 tcf (equivalent to 35.4 billion barrels of crude oil), twenty times the remaining world reserves of conventional gas.[17] Greene's 1999 study noted that there are no proven means of recovering hydrates. Since then, however, there have been unconfirmed

---

[14] "Conventional" fuel reserves do not include tar sands, shale oil, gas hydrates, coal seam methane, or oil undersea deposits at water depths of more than 2000 meters.

[15] *International Energy Outlook*, DOE/EIA 0484 (1998), table A2.

[16] "An Assessment of Energy and Environmental Issues Related to the Use of Gas-to-Liquid Fuels in Transportation," David L. Greene, Center for Transportation Analysis, Oak Ridge National Laboratory, November 1999, *supra.,* p. 13.

[17] Greene, "Assessment of Energy and Environmental Issues …," p. 14, citing USGS estimates.

reports of initial Russian success in recovering gas from hydrates, at least where the hydrates are colocated with gaseous methane that can be extracted to cause a pressure drop, resulting in sublimation of hydrates.

Source Diversity

The importance of fuels being available from a geographic diversity of sources can be seen from the discussion of energy security in the Report of the National Energy Policy Group (2001):

> *Diversity of Supply*
>
> *Concentration of world oil production in any one region of the world is a potential contributor to market instability, benefiting neither oil producers nor consumers. Periodic efforts by OPEC to maintain oil prices above levels dictated by market forces have increased price volatility and prices paid by consumers, and have worked against the shared interests of both producers and consumers in greater oil market stability. ...*
>
> *Encouraging greater diversity of oil production and, as appropriate, transportation, within and among geographic regions has obvious benefits to all market participants.*[18]

Currently, two commercial plants make FTD from natural gas, one in Malaysia and one in South Africa. Another semi-commercial plant also operates in South Africa along with a commercial scale plant making FTD from coal, which is to be converted to natural gas. A commercial scale project has been announced to make FTD in Nigeria as well as a semi-commercial scale one in Peru, along with two announced projects in the Persian Gulf, both in Qatar. In addition, Shell Oil has announced plans to construct an additional four FTD plants in some combination of the following countries: Egypt, Indonesia, Trinidad-Tobago, Argentina, Malaysia, and Australia. Rentech is working toward converting a methanol plant to FTD in Colorado (semi-commercial scale) and promoting an FTD project in India. Another project is under study in Chile. Thus, of the twelve existing or planned commercial plants, only the two Qatar plants would be in the Persian Gulf, with a possible third elsewhere in the Middle East region (Egypt), and three additional semi-commercial plants exist or are planned outside that region.

A 1993 study of gas potentially available for production of liquid fuels found that almost all the sources of low cost non-associated gas[19] (e.g. under $1.00/mcf in 1989$) are located in the Middle East.[20] A 1999 study found that to be competitive as a transportation fuel (with crude oil selling in the $15-20/bbl range) FTD would have to be produced from gas priced on the order of $0.50/mcf. It also found that at least 80% of such low cost gas was concentrated in three Persian Gulf countries, with the only other

---

[18] *National Energy Policy*, May 2001, *supra...*, p. 8-6.

[19] Gas not "associated" with production of crude oil. Almost all crude oil production involves by-product gas which can either be captured for further processing or liquefying, reinjected (which enhances oil recovery) or vented/flared. The strong trend worldwide has been toward elimination of venting/flaring except for minimal levels that are impracticable to avoid. Of all the announced FTD projects, only the Chevron Nigeria project would use associated gas.

[20] *Technical Report Nine: Development Costs of Undeveloped Nonassociated Gas Reserves in Selected Countries*, U.S. Department of Energy, Office of Domestic and International Energy Policy, January 1993, p. 3.

significant sources being Algeria and Indonesia,[21] both of which are considered potentially unstable. These economic analyses would suggest that essentially all FTD production other than that from associated gas would be in the Persian Gulf, a greater concentration than for crude oil production. If this were true, substitution of FTD for conventional diesel fuel would arguably make the oil importing countries more vulnerable to supply interruptions. While the economic analysis seems to be sound, the geographic concentration it suggests does not seem to be confirmed by the empirical evidence as described above.

Based on the empirical evidence, it seems likely that FTD production will be geographically diverse and possibly lessening the concentration of transportation fuel production in the Persian Gulf region.

Energy Efficiency Concerns

Notwithstanding the four factors suggesting that FTD will provide energy security benefits, DOE must be concerned with the possibility of other factors that could offset these potential sources of benefit. With regard to FTD, one such concern is the energy efficiency of the FTD production processes.

Argonne National Laboratory has completed a study in support of this rulemaking on the energy consumed in production and use of FTD fuel as compared to conventional diesel fuels.[22] The range of estimates generated by the study, using Argonne's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model, is fairly wide and suggests that there could be substantial efficiency losses with some FTD production.

The study shows that on average, "well-to-wheel" energy use per Btu of fuel used for FTD made in stand-alone plants is 44% greater than that for conventional diesel fuel meeting the 15 ppm sulfur standard which will be phased in starting in June 2006.[23] The study generated probability-based estimates to address uncertainties involved in FTD technology developments. The study showed that the increase in energy use per Btu of fuel delivered to the engine by FTD could range from 34% to 58%. Partially offsetting these energy losses by FTD is a 4% higher per Btu fuel economy for FTD over conventional diesel.[24] The Argonne study also estimated energy use based on data in the petitions provided by the three petitioners. With Mossgas technology, FTD may increase well-to-wheel energy use by 42%, Syntroleum by 54%, Rentech by 62%, all relative to energy use for 15 ppm conventional diesel fuel.

---

[21] "Assessment of Energy and Environmental Issues …," Greene, *supra*., 1999, p. 14, p. 35, p. 38.

[22] "Assessment of Well-to-Wheel ...," Wang, *supra*.,. Docket No. EE-RM-02-200-1B .

[23] FTD plants with electricity exports actually have worse energy efficiency than stand-alone plants (after adjustment for the more efficiently produced electricity that would be displaced), while those with steam exports have somewhat better efficiency (though many expected FTD plant locations may not have practical markets for such steam exports).

[24] "Assessment of Criteria Pollutant Emissions from Liquid Fuels Derived from Natural Gas," Teresa Alleman, Robert McCormick, and Keith Vertin, National Renewable Energy Laboratory, pp. 23-24, Docket No. EE-RM-02-200-1C. The 4% fuel economy differential is based on actual vehicle testing. The basis for the differential is not known but it is likely related to the lower energy content of FTD per gallon relative to conventional diesel fuel.

While DOE is concerned about the energy losses from FTD production, it does not see these efficiency concerns as necessarily disqualifying any FTD from designation as an alternative fuel. A number of options are available to DOE in regard to the efficiency issue:

- DOE could find that the other energy security advantages of FTD are so significant that efficiency differentials can be disregarded, or

- DOE could set a standard for energy use per Btu of fuel produced as a condition of the designation.

Under the second approach, any FTD produced with processes that use less than the limit value of energy in production would be classified as alternative fuels, while those that use greater than that amount of process energy would not be alternative fuels. Such a limit might not apply if it could be shown that the FTD is made from gas that would otherwise be "stranded" or reinjected (or vented/flared). Such limit values could be set, for example within the range of 34% greater energy use than ultra low sulfur diesel (<15 ppm sulfur) (Argonne's low end aggregate estimate) to 62% (Argonne's estimate for Rentech's process) or even greater.

DOE requests comment on whether the setting of process energy use limits within an EPAct designation is a necessary, sufficient and appropriate way to assure that FTD qualifying under EPAct would provide substantial energy security benefits. If so, DOE specifically requests comment on what levels such limits should be set at.

IV. SUBSTANTIAL ENVIRONMENTAL BENEFITS

EPAct does not define the term "substantial environmental benefits" as used in sec. 301(2). DOE believes that Congress principally had air emission impacts in mind but that other environmental benefits and detriments should be considered as well.[25]

A major focus of the "substantial environmental benefits" referred to in sec. 301(2) is emissions of greenhouse gases. These emissions are referred to repeatedly in Title V of EPAct; they are the only environmental benefits mentioned specifically in the statute. Sec. 502 of EPAct calls on DOE to establish an overall program for maximum practical use of domestic replacement fuels (which includes alternative fuels), stating the program goals:

> "*Such program shall, to the extent practicable, ensure the availability of those replacement fuels that will have the greatest impact in reducing oil imports, improving the health of our Nation's economy and **reducing greenhouse gas emissions***." (emphasis added)

---

[25] The term "environmental" can have very broad connotations as in the National Environmental Policy Act, which requires environmental assessments of major federal actions. "Environmental" under NEPA has been interpreted to include a wide range of direct and indirect health and welfare effects on communities such as congestion, noise, tax revenues, etc. DOE believes that the benefits referred to in sec. 301(2) have a somewhat narrower meaning but that a fairly wide range of possible adverse impacts (affects on vehicles) should also be considered.

These sec. 502(a) program goals, including reduction of greenhouse gases, are the principle goals DOE is to pursue in its implementation of the Title V AFV programs, as shown in other sections such as sec. 502(b)(4), sec. 504(a), sec. 504(c), and sec. 507(l).

While these related sections of the statute focus on greenhouse gases, DOE interprets "substantial environmental benefits" to include other factors as well. The clearest and most obvious indicator of this is the broader language of sec. 301(2) itself in contrast to the "*greenhouse gas*" language of the other provisions. Secondly, the legislative history of these provisions indicates that other environmental concerns were at least as important as greenhouse gases to legislators.[26] Finally, current U.S. environmental policy and laws generally give much higher priority to reducing those forms of pollution that have more direct impacts on or risks for human health and welfare.

DOE believes that the environmental impacts to be considered in regard to sec. 301(2) designations are:

- criteria pollutant emissions (principally from vehicles)
- greenhouse gas emissions (from vehicles and fuel production/distribution)
- toxic pollutant emissions (principally from vehicles)
- other environmental impacts, such as groundwater pollution, marine pollution, etc. as related to biodegradation, ecotoxicity, etc.

Sec. 301(2) does not require that a fuel offer substantial benefits in regard to each of these environmental factors. The substantial benefits can derive from any one of the categories or a combination of them. If a fuel offers substantial benefits in one category or a combination of them but is neutral in impact in other categories, it may be designated under the EPAct language.

DOE believes that sec. 301(2) allows it to designate fuels that offer substantial benefits in one category even if some detriment is caused in another category, provided that any detrimental effects are not significant and that the overall environmental effect, weighing risks against benefits, is substantially beneficial. ***DOE is interested in using such an approach in this rulemaking and for sec. 301(2) designations generally and invites comment on whether such an approach is desirable.***

Criteria Pollutants

DOE believes that FTD fuels are likely to offer reductions of criteria pollutants relative to both current and future conventional diesel fuels, based principally on the low aromatic and sulfur content, high cetane, high paraffin, high normal paraffin, and/or high hydrogen/carbon ratio levels associated with the FTDs. In the case of NO_x emissions, DOE believes that existing data show statistically significant reductions of at least 6-20% to result from such aromatic and cetane levels. DOE is concerned regarding lack of data on FTD emissions over the general vehicle population but believes that existing aggregated FTD data along with data on emissions impacts relating to diesel fuel properties generally, could provide a basis for a finding of substantial environmental benefits. DOE is also concerned regarding lack of data on durability and materials compatibility and particularly encourages any parties possessing such data to provide it to DOE.

---

[26] See, e.g., Congressman Alexander's comments in consideration of the Conference Report on H.R. 776, *Congressional Record (House)*, October 5, 1992, reprinted in *Legislative History of the Energy Policy Act of 1992*, Congressional Research Service, Nov. 1994, p. 4536, specifically speaking of reducing toxic air pollutants and emissions impacts on plant life.

A report on FTD criteria pollutant emissions was prepared for this rulemaking by the National Renewable Energy Laboratory (NREL).[27] The report distinguished between FTD fuels (those for which most or all of the diesel fuel is a direct product of the Fischer-Tropsch synthesis) and FT/COD ("conversion of olefins to distillate") fuels (such as the Mossgas fuels, most of which are produced by substantial conversion of FT products outside the diesel distillation range to hydrocarbons within that range). The FT fuels share common characteristics, typically being almost completely paraffinic and with near zero sulfur levels while the FT/COD fuels can have aromatics in the range of 15-20% and may also have some olefin content. Mossgas reported sulfur levels of up to 10 ppm for its fuels but it is not clear if this reflects real sulfur levels or shortcomings of the analytical methods used, most of which do not have the resolution needed to measure sulfur content below 10 ppm within a range of one or two ppm.

NREL found a pattern of data being insufficient to make statistically significant estimates of emissions impacts of FTD on most of the key questions and comparisons relevant to the rulemaking. In many cases the data were non-existent. NREL was able, however, to make statistically significant estimates of reductions of NOx emissions expected from substantially reducing fuel aromatics content and raising cetane to levels associated with some or all FTD fuels (but not expected with conventional diesel fuels) in pre-1998 engines. Aggregating existing data on both FTD and diesel fuel parameter effects generally also gives reason to expect reductions of particulate matter, hydrocarbons and carbon monoxide (CO), despite the lack of statistically significant quantitative estimates. Therefore, FTD meeting defined fuel parameter limits would almost certainly have lower criteria pollutant emissions, particularly NOx, than conventional diesel fuels.

NREL's findings include the following:

> While a sec. 301(2) designation would relate principally to the fleet AFV programs of Titles III and V of EPAct, no test data on use of F-T or FT/COD in AFVs, i.e. vehicles designed and built to run on alternative fuels,[28] have been submitted or identified. Absent such data, NREL evaluated existing emissions data on use of the FTD fuels in conventional vehicles for comparison to conventional diesel fuels. (See Section VI.)
>
> No emissions data were identified by NREL on vehicles with emissions control devices similar to those likely to be adopted to meet EPA's MY 2004 and MY 2007 heavy-duty diesel engine emission standards. Nor was any identified on post-1998 engines, which are believed to show different responses to fuel changes such as cetane levels.
>
> Starting in 2006, the baseline in-use diesel fuel in the U.S. will be limited to 15 ppm sulfur, which will reduce emissions as well as enable use of emission control devices that will reduce emissions quite substantially (possibly 95% according to EPA). There are very little data comparing emissions from the FTD fuels with emissions from these ultra low sulfur baseline fuels. Syntroleum submitted data for 3 vehicle models comparing an FTD test fuel to Swedish City Diesel, which would meet the EPA 2006 standards. The FTD fuel showed some emissions reductions relative to the Swedish fuel

---

[27] "Assessment of Criteria Pollutant Emissions …," Alleman, McCormick and Vertin, *supra.*, Docket No. EE-RM-02-200-1C.

[28] EPA "low sulfur diesel," i.e. <500ppm, except for the data submitted by Rentech, which used a control fuel having <3,000 ppm sulfur.

on the vehicle models tested but most of the results were not statistically significant. The data set was inadequate in number of data points and in representing the variety of vehicle characteristics to be statistically significant for the overall vehicle population.

Each of the petitioners submitted a limited amount of emissions data comparing FT and FT/COD fuels to conventional No. 2 diesel fuel. Most of these results were statistically significant on an individual vehicle basis. None included sufficient quantity or variety of data to represent the overall vehicle population on a statistically significant basis.

NREL aggregated the petition data with other existing data on FTD emissions relative to No. 2 diesel. These data still were insufficient to represent the overall vehicle population but did include a range of vehicle characteristics. NREL applied the Wilcoxon Signed-Rank test to these data and showed a 99% probability that each regulated pollutant would be reduced with FTD by some (non-zero) amount. The reductions could not be quantified with any statistical significance.

It is generally recognized that diesel emissions levels can be related to key fuel properties such as aromatic level, cetane number, sulfur content, density, and others. FTD fuels are expected to have many of these key properties, leading to lower emissions while FT/COD fuels share them to a lesser degree. EPA's project to develop a model of diesel fuel properties' emissions effects has not yielded adequate results to date on which DOE could estimate emissions reductions generally from FTD fuels. NREL was, however, able to obtain a statistically significant estimate of NOx emission reductions expected from the decreased aromatics and increased cetane number of FTD fuels: 6-20%.

Differences in such fuel properties between different FT fuels are likely to be related more to plant specific factors, operating conditions, and post-synthesis processing than to proprietary FT technologies. Neither of the FT petitioners (Syntroleum or Rentech) established any analytical basis for concluding that emissions reductions were related significantly to its proprietary process or that test fuels used in emissions testing reflected its proprietary process generally or as distinct from other FT fuels. Syntroleum, for example, offers "several" proprietary catalysts but its test fuel apparently only represented one of these.

No durability emissions data were provided or otherwise identified by NREL. A similar dearth of data on materials compatibility was also noted although some elastomer immersion test data developed by Sasol were identified and did not indicate adverse effects on two key elastomers from the FTD. Concerns have been expressed in the past regarding elastomer impacts of very low aromatic fuel. Some of the emissions benefits noted with the zero aromatic test fuels might not be realized if FTD fuel providers add aromatics to their fuel to avert potential adverse elastomer impacts.

NREL did not identify any detailed compositional data either within the petitions or in published literature. Some FTD fuels are believed to have poor cold flow properties, possibly as a result of excess concentrations of n-paraffins. Isomerization of these n-paraffins could sacrifice some of the cetane benefit of the FTD fuels. Other FTD fuels might be more volatile than the ASTM D-975-02 specifications. DOE believes that these problems can be avoided by requiring adherence to ASTM D-975-02 as a condition of any sec. 301(2) designation.

The NREL study suggests that a DOE designation of FTD fuels with aromatics controlled to a maximum of 10% by volume and cetane number of 75 would provide engine-out NO_x reductions with pre-1998 engines in the 6-20% range even when compared to post-2006 diesel fuel. Other pollutant emissions would also most likely be reduced though statistically significant quantitative estimates cannot be made for them. DOE has some concerns, however, whether these parameters would assure such emissions benefits on later model and future model diesel engines to the same degree as older engines.

EPA has recently released a report on the effects of cetane number on diesel engine emissions.[29] In this report, EPA estimates the maximum NOx reduction due to increase in fuel cetane number to be up to 6%. But for engines using EGR (being phased in starting in October 2002) EPA found no discernable trend of NOx reduction with increase in cetane number. Based on the EPA data, it would suggest that up to 6% of the decrease NREL found might be due to cetane number, and that engines with EGR would show a smaller range of decrease than 6-20%.

All of the commercial engines represented in the NREL data set are older engines that are acknowledged to be more sensitive to fuel cetane number than current and anticipated future engine designs that use higher injection pressures and controlled injection rates and/or multiple injections.[30] By controlling the rate of fuel injection, these engines lengthen the duration of combustion and lower the peak flame temperature, which directly impacts NO_x formation. Such newer design engines do not show any discernable trend of lower NO_x emissions with increase in cetane number into the range of cetane numbers representative of FTD fuels.[31] However, these engines do show reductions in NO_x emissions using low-density, low-aromatic fuels similar to FTD fuels (such as Swedish City Class 1) that are in the same range as those observed by older engines using FTD fuels (e.g., approximately 20% reduction).[32] In testing conducted using three prototype light-duty direct injection diesel engines where the injection timing was adjusted to compensate for cetane number among the test fuels, a 100% FTD showed an average reduction in NO_x of 16% relative to a CARB-specification diesel fuel (the reduction in NO_x relative to conventional No. 2 diesel fuel would no doubt have been slightly higher).[33] In diesel engines that use NO_x emission control devices (expected in 2007 for heavy-duty diesel engines and possibly before 2007 in light-duty engines), the percentage reductions in engine-out NO_x emissions are likely to be similar in percentage terms. (FTD is unlikely to affect the conversion efficiency of NO_x emission control devices.) Tailpipe emissions reductions, however, will be much lower in absolute terms.

---

[29] "The Effect of Cetane Number Increase Due to Additives on NOx Emissions from Heavy-Duty Highway Engines - Draft Technical Report," EPA420-S-02-012, June 2002.

[30] EPA HDEWG Program-Engine Test Results," by T.W. Ryan, et.al., Southwest Research Institute, R.A. Sobotowski, et.al., Cummins Engine Company, G.W. Passavant, EPA, and T.J. Bond, BP Amoco. SAE Paper 2000-01-1858 presented at the SAE International Fuels & Lubricants Meeting, June 19-22, 2000.

[31] NO_x reductions have been observed in one test on such engines with increasing cetane in the range of 40-50, but it has been pointed out that this engine was optimized for 50 cetane, which may account for that effect. "Fuel Effects on Diesel Emissions - A New Understanding," by Y. Kwon, et.al., Esso Research Centre, R. Haugland, et.al., Statoil PKS Fuels Technology, and G. Wilson, Rover Group. SAE Paper 2001-01-3522 presented at the SAE International Fuels & Lubricants Meeting, May 6-9, 2002.

[32] *Ibid.*

[33] "Overall Results: Phase I Ad Hoc Diesel Fuel Test Program," T.E. Kenney, et.al., Ford Motor Company, J.C. Eckstrom and L.R. Wolf, BP Amoco, S.J. Korn, DaimlerChrysler, and P.G. Szymkowicz, GM R&D and Planning. SAE Paper 2001-01-0151 presented at the SAE World Congress, March 5-8, 2001.

These tests of new and prototype engines show that the type of hydrocarbons in the fuel is more important than the cetane rating of the fuel in terms of the NO_x reductions from such engines. NREL pointed out that a minimum normal paraffin specification could be an alternative to a cetane specification since it was the high n-paraffin content that accounted for the high cetane of the FTD fuels. Test data identified by DOE to date, however, are insufficient to determine if the NO_x reduction observable with FTD fuels in the new engine types is attributable to high n-paraffin content, high total paraffin content, higher open-chain paraffin (i.e. non cyclo-paraffin) content, range of carbon numbers, or other parameters. Therefore, it cannot be determined to what extent emissions reductions observed on FTD test fuels will be representative of in-use FTD fuels when used in later model engines. Data on the actual composition of test and control fuels for which emissions data have been reported would be very helpful in this regard. ***DOE specifically requests comment on this issue and requests that any parties possessing data relevant to these questions submit them for consideration in the rulemaking.***

DOE requests comment on whether emissions benefits in the range of 6-20% might or might not be considered "substantial" within the meaning of sec. 301(2).

Comment is requested on what levels parameter limits should be set at to assure emissions reductions based on the NREL study and/or other sources. For example, a designation could incorporate parameters in the ranges such as:

- ***Aromatics maximum set within the range of 1%-15%***
- ***Cetane minimum set within the range of 53-75 and/or limit on hydrocarbon composition***
- ***Sulfur limit set within the range of 5-15 ppm***
- ***Conformity to ASTM D-975-02 and all applicable state and federal regulations required.***

DOE specifically requests comment on whether FTD fuels with aromatics content in the low end of the range suggested above are likely to result in materials compatibility problems, such as fuel pump failures. DOE also specifically requests comment on whether a limit on polyaromatic content should be included either in addition to or in lieu of a limit on total aromatics.

DOE also requests interested parties to submit any additional emissions data not cited in the NREL report.

Greenhouse Gas Emissions

As indicated above, various subsections of EPAct indicate that emissions of greenhouse gases (GHGs) are a key element, if not the single key element, in the EPAct environmental benefits criterion. DOE had the Center for Transportation Research of Argonne National Laboratory (ANL) prepare an assessment of the greenhouse gas and energy use impacts of FTD fuels as compared to both conventional No. 2 diesel fuel and post-2006 ultra low sulfur diesel fuel.[34]

ANL made estimates of energy use and GHGs in production ("well-to-pump"), in vehicle use ("pump-to-wheel") and in combination ("well-to-wheel") using the Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) model. It ran sets of estimates on composite production of:

---

[34] "Assessment of Well-to-Wheel Energy Use and Greenhouse Gas …," Michael Wang, *supra*., Docket No. EE-RM-02-200-1B.

Conventional diesel fuel
Ultra low sulfur fuel
FTD in stand-alone plants (produced natural gas)
FTD in plants with electricity exports (produced natural gas)
FTD in plants with steam exports (produced natural gas)
FTD in stand alone plants from gas that would otherwise be flared

For each of these composites, ANL generated probability-based estimates with ranges to address uncertainties involved in technology development. As with the criteria pollutant emissions, DOE believes the most meaningful comparisons are to ultra low sulfur diesel since that will be the standard for all U.S. diesel fuel from 2006 onward. All estimates are for 1,000,000 Btu of final diesel fuel in the ANL report. Adjustments were made here to take into account the 4% gain in fuel economy from petroleum diesel to FTD.

In general, production of FTD with stand-alone plants (well-to-pump) was shown to result in approximately twice as many GHG emissions as ultra low sulfur diesel fuel (and more than twice as many as conventional diesel fuel). FTD, however, had approximately 7% lower GHGs from the vehicles (pump-to-wheels), which accounts for 2-3 times the mass of the GHGs from the fuel production. On the per 1,000,000 Btu basis, the total well-to-wheel GHG estimates for FTD were 6-18% greater than those for ultra low sulfur diesel, with an average value of 12%. As indicated above, however, FTD was also estimated to get approximately a 4% gain in fuel economy relative to ultra low sulfur diesel; so, on the per mile basis, the GHG emissions for FTD were 2-13% higher than those for ultra low sulfur diesel, with an average value of 8%.

FTD use from plants with electricity export (crediting the FTD production for the reduction of GHGs from the electricity that is displaced) had well-to-wheels GHG emissions 0-14% higher than ultra low sulfur diesel, with an average value of 7%, all on the Btu basis. On the per mile basis, this option of FTD production could have a 4% reduction to 9% increase in well-to-wheel GHG emissions, with an average value of 3% increase.

FTD use from plants with steam export had lower GHG emissions than ultra low sulfur diesel on a per mile basis. The per-Btu estimates ranged from a 16% reduction to a 3% increase, with an average value of a 6% reduction. On the per-mile basis, this option of FTD production had a 1-19% reduction in GHG emissions, with an average value of 10% reduction.

ANL also estimated emissions for FTD production and use for plants using the "processes" of the petitioning companies based on data supplied by the companies. For Mossgas, this are actual plant process data while for the other petitioners it are apparently data reflecting pilot runs and/or bench scale production. For Syntroleum and Rentech, estimates were prepared for plants with electricity as well as stand-alone plants. Estimates were also generated for use of an FTD process using Syntroleum technology in plants with steam exports and in plants using flared gas. These estimates were consistent with the ranges of estimates noted above, with Syntroleum's GHGs about 2.8% lower than Rentech's, while Mossgas's were about 6.3% lower than Syntroleum's.

DOE believes that most FTD plants will be located in remote locations where steam exports will not be practical and that electricity exports will also probably be made from a minority of plants. While DOE prefers to avoid plant-by-plant determinations, in the event that DOE makes favorable determinations on other criteria, a number of options could be available to DOE:

DOE might designate all FTD meeting the defined fuel parameters, based on the rationale that GHG increases are not so significant as to offset the expected criteria pollutant emission benefits.

DOE might set standards for GHG emissions per unit of fuel output, with FTD fuel from those plants falling below those emission levels (and meeting fuel parameters) treated as alternative fuel.

DOE might determine that only FTD from plants with steam or electricity exports of a certain proportion to output should qualify as alternative fuel.

DOE requests comment on which of these options would be most appropriate. DOE also requests comment on the levels at which any GHG emission standards should be set if that option were to be chosen and whether a producer with more than one plant should be allowed to average the GHG emissions of various plants (e.g. some with and some without steam exports) to meet such a standard.

Use of Flared Gas

Substantial reductions of global warming potential would be realized if FTD were to be made from gas that would otherwise have been flared or vented. Not only would large volumes of CO_2 from the unnecessary combustion of the gas be eliminated but releases of methane, which are much more potent than CO_2, would be avoided. The ANL study showed GHGs (in CO_2 equivalent grams per million Btus of fuel delivered) with use of FTD made from flared gas to range from a reduction of 288 grams at P10 to generation of 24,762 grams produced at P90, with a P50 value (median estimate) of 12,979 grams. These compare with estimates in the range of 97,000-105,000 grams produced for conventional and ultra low sulfur diesel and 82,000 to 123,000 grams produced for FTD from natural gas. It can be seen that even the P90 estimate for FTD from flared gas is less than 1/3 of the lowest of the other options.

In order for GHG benefits to be obtained from use of flared gas for FTD, however, it must be assured that the gas would in fact have otherwise been flared in the absence of the FTD production. The mere facts that gas is "associated" and/or that it was flared up until the time of its use for making FTD is insufficient to determine that it would have otherwise been flared indefinitely.

No more than a very small percent of FTD will most likely ever be shown to be made from gas that would otherwise have been flared. Moreover, existing information is inadequate to base regulations on any such projections or to attribute to FTD production overall some pre-selected proportion of production from flared gas. The differences in GHG emissions between FTD production from flared gas and from natural gas reserves are so vast that they must be seen as two separate phenomena. Production of FTD from a large plant that increases GHG emissions over conventional diesel substantially should not be credited with offsetting GHG reductions from plants that other parties operate, let alone from some hypothetical set of future plants that might or might not come into being.

The difficulties inherent in determining that certain sources of gas would otherwise be flared indefinitely are formidable, as indicated by recent suggestions regarding such use for FTD. The Oak Ridge National Laboratory (ORNL) report, for example, states, "Natural gas that is currently vented or flared is a particularly attractive target for G-T-L conversion … Of the 3.8 tcf vented or flared in 1995, ... 284 bcf [is attributed] to the United States." It further claims that the 3.8 tcf of gas vented, flared or re-injected in the United States each year is enough to make 16 billion gallons of distillate fuel, roughly half the amount consumed on U.S. highways each year.[35] The Syntroleum petition was more direct still in making such claims: "As mentioned above, in 1997, the United States alone produced 0.26 tcf of vented or flared gas, which could produce 800 million gegs [gasoline equivalent gallons] of S-2."[36]

In reality there is virtually no gas being vented or flared in the U.S. that represents a viable source of feedstock for GTL production. Flaring and venting of gas are illegal throughout the U.S. with exceptions made for a number of very limited circumstances, all of which involve gas that is either flared temporarily or is economically unusable[37]. The figures cited by Greene and Syntroleum, which were published by the *Oil and Gas Journal* and EIA (compiled originally by Sedigas), represent about 1% of U.S. gas production. These gas volumes are simply the cumulation of thousands of incidents of venting of gas, each of which is performed because the volume and/or quality of the gas preclude its use.

None of the situations for which venting and flaring is allowed provides any substantial opportunity for production of GTL. GTL is one of the options available to oil producers as an alternative to venting/flaring of associated gas. In the absence of the GTL option, however, the gas would not be vented or flared but otherwise disposed.

While the volumes and percentages of flaring are clearly higher for other parts of the world than for the United States, the same principles apply generally; economics, management, and environmental concerns dictate that flaring normally be done only temporarily, in small volumes, or in special circumstances. A trend toward elimination of flaring is observable from year-to-year data. Regions that are exceptions to this are generally those which are least hospitable to U.S. investment and technology, such as Iraq, Iran, and parts of Africa. For example, the 0.914 tcf shown as flared and vented in the Middle East in1996 data (from EIA's *International Energy Annual 1996*, Feb. 1998) has fallen to 0.544 tcf by 1999, of which 0.404 was in Iran and Iraq, countries which are under U.S. and international economic sanctions.

Of the 13 existing and planned FTD plants, only Chevron's planned Nigeria plant would use associated gas. The gas to be used in that project is currently being flared and will be flared up until the time it is captured for FTD. Strong local and political pressures exist for elimination of the flaring. Shell has chosen to use an LNG plant for its share of the gas, has already implemented it, and has eliminated its flaring. Chevron's FTD plant, due at least in part to ongoing technology development, is years behind the Shell project. In this case, it certainly appears that the use of FTD for disposition of the gas has resulted in flaring for a few years beyond what would otherwise have been the case.

---

[35] "An Assessment of Energy and Environmental Issues …," David Greene, 1999, *supra*., p. 40. The two values shown as 3.8 tcf are apparently the same by coincidence.

[36] Syntroleum petition, p. 14. See also similar statement on p. 10.

[37] The Minerals Management Service of the U.S. Department of the Interior (DOI) regulates gas production in the outer continental shelf. Its regulations for venting and flaring of gas are found at 30 CFR 250.1105. They allow for venting or flaring of gas only in the limited circumstances indicated above. Regulation within the 50 states is by individual states. DOE understands that all energy producing states in the U.S. have regulations prohibiting flaring that are at least as stringent and generally more so than the DOI regulations. A sample summary of such regulations in eight states as of 1991 is given in *Technical Report Six, supra.,* Table II-2, p. 11. Such regulations have become generally more stringent and universal since that time.

Toxic Air Pollutants

DOE believes that FTD exhaust will probably be significantly less toxic than conventional diesel exhaust based on its low or nonexistent aromatics content. DOE is concerned, however, about the lack of substantial data on the toxicity of the FTD emissions or even on the composition of the emissions. None of the petitioners has submitted, nor has DOE identified, any health effects studies nor speciated emissions test data on FTD fuels. ***DOE strongly urges any parties with such data to submit them to the rulemaking docket in the form of comments and welcomes public comment in general about toxicity issues related to FTD.***

Conventional diesel fuel emissions have been established to be quite toxic. EPA's 1994 document *Health Assessment Document for Diesel Emissions* concludes that a causal link does exist between diesel exhaust and cancer, based mainly on animal data. EPA has listed diesel particulate matter as a hazardous air pollutant (66 *Fed. Reg.* 17230, March 29, 2001). The California Environmental Protection Agency has identified diesel exhaust as a toxic air contaminant.

A March 2002 study showed long-term exposure to combustion-related fine particulate air pollution to be an important environmental risk factor for cardiopulmonary and lung cancer mortality. Fine particulate and sulfur oxide–related pollution were associated with all-cause, lung cancer, and cardiopulmonary mortality. Each 10-$\mu g/m^3$ elevation in fine particulate air pollution was associated with approximately a 4%, 6%, and 8% increased risk of all-cause, cardiopulmonary, and lung cancer mortality, respectively. Measures of coarse particle fraction and total suspended particles were not consistently associated with mortality.[38]

The aromatic content of the diesel exhaust, particularly benzene and polycyclic aromatic hydrocarbons (PAHs), are believed responsible for much of the reported toxicity. The PAHs are adsorbed onto diesel exhaust particles and some of them are believed to be carcinogenic. The particulates themselves may have intrinsic carcinogenic properties and could also contribute to non-cancer health impairments including respiratory problems and chronic lung disease. There is also some evidence that both the particulate and gaseous fractions of the diesel exhaust may have mutagenic effects. The exhaust benzene is believed to be related to the aromatic content of the diesel fuel; exhaust PAHs are most likely related to total exhaust HC as well as fuel aromatic and PAH levels.

As shown above, FTD fuels are lower in both total aromatics and PAHs than conventional diesel. The FTD fuels identified, as distinct from the Mossgas FT/COD, are virtually free of these constituents, while the Mossgas FT/COD has approximately half the content of both total aromatics and PAHs typical of conventional diesel fuels. While exhaust PAHs may not result predominantly from fuel PAH content, the lack of such fuel constituents is likely to result in some reduction of exhaust PAHs and possibly reduce other exposures to these toxins. As indicated above, available data suggest that FTD is likely to reduce

[38] "Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution," Arden Pope III, PhD; Richard T. Burnett, PhD; Michael J. Thun, MD; Eugenia E. Calle, PhD; Daniel Krewski, PhD; Kazuhiko Ito, PhD; George D. Thurston, ScD, *Journal of the American Medical Association*, Vol. 287 No. 9, March 6, 2002, pp. 1132-1141.

HC emissions, which is likely to result in less exhaust of PAHs and the absence of fuel aromatics could also contribute to exhaust PAH reductions.

On the other hand, if the FTD fuels, such as FT/COD, contain higher levels of olefins than conventional diesel, increases in emissions of 1,3 butadiene (a compound formed in fuel combustion believed to be carcinogenic and listed as a hazardous air pollutant in sec. 112(b) of the Clean Air Act) could result.

Moreover, paraffins are not free from toxic effects. A 1985 study showed that the alkane fraction of gasoline was responsible for toxic effects on kidneys with a positive structure-activity response relating the degree of alkane branching to the potency of the nephrotoxic response.[39] N-decane has been shown to cause various forms of irritation, including irritation to the upper respiratory tract which results in decreases in respiration rates and cessation of body movements in both mice (Kristeansen and Nielsen, 1998) and rats (Liu, Laster, Taheri, et. Al, 1993). It was also found to be a co-carcinogen when mixed with benzo(a)pyrene (BaP), resulting in twice the number of mice with papillomas compared to BaP alone (VanDuren and Goldschmidt, 1976). Toxicities will vary for each of the exhaust compounds and, unfortunately, DOE has not identified any data on the relative concentrations of such species in FTD exhaust.

Notwithstanding that paraffins have toxic effects, DOE believes that paraffin toxicities are generally lower than those of aromatics in general, particularly when the toxicities of the exhaust benzene and PAHs are taken into account. A German study showed paraffin vapors to be less toxic overall than those of other gasoline/diesel constituents. While vapors from all of the fuel (gasoline) constituents were found to induce narcosis, lateral positions, loss of reflexes, dilation of peripheral vessels and death, the concentrations at which these effects were observed were lowest for aromatics, followed by cyclo-paraffins. Vapors of aliphatic paraffins were the least toxic.[40] Exhaust aromatics (particularly benzene) are believed to be largely related to fuel aromatic content. Thus, DOE believes that FTD fuels are likely to be less toxic than conventional diesel fuels in this regard, despite the lack of speciated emission comparisons.

Syntroleum did provide emission test results for its FTD test fuel compared to various conventional diesel fuels for a number of toxic air pollutants: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde. The FTD fuel was consistently lower than the other diesel fuels (including CARB diesel and Swedish City Diesel) for benzene, formaldehyde and acetaldehyde. For 1,3 butadiene, the FTD had mixed results compared to CARB and Swedish City diesel but was lower than No. 2 diesel in all tests. The totals of these toxics for the test fuel were lower than for any of the other fuels on the three test vehicles. The data submitted by Syntroleum was insufficient for any statistical significance.[41] The test fuels used by Syntroleum were not necessarily fully representative of likely FTDs in future commercial production and species-specific composition data were not shown for it. The data were from vehicles without emissions control devices, as are expected to be in-use from MY-2007 onward.

---

[39] "Hydrocarbon nephropathy in male rats: Identification of the nephrotoxic components of unleaded gasoline," C.A. Halder, C.E. Holdsworth, B.T. Cockrell, V.J. Piccirillo, *Toxicology and Industrial Health*, 1 (3), 1985, pp. 67-88.

[40] "The Toxicology of Gasoline," N.W. Lazarew, *Archives für Hygiene*, pp. 227-239.

[41] "Assessment of Criteria Pollutant Emissions …," Alleman, McCormick and Vertin, *supra.*, Docket No. EE-RM-02-200-1C, pp. 31-32.

Biodegradability and Ecotoxicity

Few data have been provided or identified by DOE on the relative degradabilities and ecotoxicities of FTD. Despite concerns over the lack of such data, DOE believes that the similarities between FTD and conventional diesel are sufficient to conclude that the biodegradation of FTD will not be inordinately less than conventional diesel.

Mossgas has provided documentation for biodegradability in response to DOE's questions. Table 2 shows the degradability of the RFD1 fuel, COD and Synthol Light Oil (SLO) components compared to kerosene. In general, chemicals that are degraded 60% during the test period are considered biodegradable by the OECD methods[42]. Under aerobic conditions, the Mossgas synthetic fuel shows similar results to kerosene. Under anaerobic conditions, the Mossgas fuel shows degradability greater than the kerosene under certain test conditions. Based on these results, the Mossgas FT/GTL diesel fuels are likely equivalent to conventional diesel fuel with respect to biodegradability.

Table 2. Biodegradability of RFD1 Fuel, COD and SLO Components and Kerosene

	Aerobic Degradation		**Anaerobic Degradation**	
Sample Concentration	**2 mg/L**	**5 mg/L**	**5 mg/L**	**10 mg/L**
COD	35.3%	42.5%	15.5%	47.2%
SLO	38.8%	13.0%	22.6%	16.7%
RFD1	9.0%	35.8%	9.1%	49.1%
Kerosene	59.2%	38.9%	81.5%	12.1%

Syntroleum submitted biodegradability data, the only which it has available, based on partial results from an air-blown aerobic test, ASTM D5864, Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components. In this test, the biodegradation of a sample is measured by collecting and measuring the CO_2 produced when the sample is exposed to microorganisms under controlled aerobic aquatic conditions. This test is designed to measure CO_2 production from the sample over a 28 day period. During this analysis of its FTD test fuel, after about two weeks of very active aerobic activity (as determined by the CO_2 evolution) the sample evaporated and the aerobic activity went to zero. Syntroleum states that it "is evaluating the appropriateness of this test method for highly biodegradable fuels such as S-2 [its FTD trade name]."

In addressing the question of biodegradability, Syntroleum stated that "*It should be noted that saturated FT lubricants in the boiling range of S-2 are the preferred base oils for drilling mud formulations used in offshore drilling because of their known benign environmental qualities*."[43] DOE strongly disagrees with this statement. To the contrary, EPA's Office of Water has promulgated a regulation that effectively bans use of the purely paraffinic FT drilling fluids in U.S. waters. The regulation includes a performance test for biodegradability, the "marine anaerobic closed bottle biodegradation test" (ISO 11734).[44] It is recognized

[42] "Detailed Review Paper of Biodegradability Testing, Environment Monograph No 98", OECD, 1995.

[43] Syntroleum supplemental submission in response to DOE questions, p. 7, question 10.

[44] "Final Rule on Effluent Limitations Guidelines for Use of Synthetic Drilling Fluids in Oil and Gas Extraction," 66 *Fed. Reg.* 6850, January 22, 2001. Biodegradation test at p. 6864.

that the paraffinic FTD oils fail this, though they might be reformulated into mixtures with olefins or esters that would pass. While rejecting Syntroleum's assertion that use of FT oils as drilling fluids demonstrates their biodegradability, DOE does not believe that the failure of such paraffinic fluids in such marine focused tests negates any environmental benefits as fuels. (Conventional diesel is also banned from use as drilling fluids.)

DOE has identified one additional biodegradability test on FTD fuel that was performed by Sasol on its Slurry Phase Distillate (SPD) fuel.[45] Although composition data are not given for the test fuel, the paper indicates that hydocracking and hydroisomerisation are used, consistent with a Sasol patent, which would substantially increase the proportion of iso-paraffins to n-paraffins. The branched structure makes iso-paraffins more readily degradable than n-paraffins in many circumstances. Since not all FTD is expected to undergo such processing, the Sasol SPD is not necessarily representative of the degradability of FTD generally. Sasol performed a test with the OECD's Modified Sturm Method 301B. The test represents aquatic aerobic conditions rather than the anaerobic conditions associated with most leaks of underground storage tanks. The standard for passing this test is 60% biodegradation in 28 days. Sasol's data show relatively close rates of degradation for the SPD and No. 2 diesel up until day 24, when the SPD degradation shoots up sharply to reach the 60% mark exactly on the 28th day.

The principal difference between the FTD and conventional diesel fuel is in the relative proportions of paraffins and aromatics. Paraffins are generally degradable via the beta oxidation pathway, among others, though less so with increasing carbon number beyond about C_{12}.[46] The degradation rates are not substantially different from aromatics.[47] Although not generally understood, according to one authority, paraffins are inherently more degradable than aromatics, but the greater solubility of aromatics causes them to disperse and be exposed to microbes faster than paraffins so that data from actual field releases typically show aromatics to have degraded more than paraffins.[48] Isoparaffins may provide more access to microbes than n-paraffins. Relative to other types of materials, such as halogenated compounds, however, the differences among hydrocarbons are not great.

As with toxicity, DOE believes that FTDs are likely to have biodegradation qualities that are acceptable for general fuel marketing applications, though additional data would be helpful to this rulemaking.

Oxygenate Issues

The NREL assessment (pp. 20-21) raised concerns about possible toxicity, ecotoxicity, and emissions toxicity resulting from certain oxygenated compounds. Such compounds could be present in FTD fuels

---

[45] Reported in "Some Comparative Chemical, Physical and Compatibility Properties of Sasol Slurry Phase Distillate Diesel Fuel," Paul Morgan, Carl Viljoen, Piet Roets, Paul Schaberg, Ian Myburgh, Jocobus Botha and Luis Pl Dancuart, SAE Technical Paper Series, 982488, October 12, 1998, p. 4, p. 8.

[46] See, e.g. *Land Treatment of Hazardous Wastes*, J.F. Parr, P.B. Marsh, and J.N. Kia (eds.), Noyes Data Corporation, Park Ridge, New Jersey, 1983, p. 327, peer reviewed and reported in HSDB.

[47] See, e.g. "Intrinsic Bioattenuation for Subsurface Restoration," Hanadi Rifaie, Robert Borden, John T. Wilson, and C. Herb Ward, in *Intrinsic Bioremediation*, Robert Hinchee, John T. Wilson, and Douglas C. Downey (eds.), Battelle Press, pp. 5-8.

[48] Telephone interview with John T. Wilson , EPA Groundwater Protection and Remediation division.

either through the FT synthesis or through the blending of oxygenated additives. Rentech proposed a limit of 1% oxygen content, while Mossgas's petition included one formulation, "RFD 3," with 5% "Mosstanol 120 Alcohols" resulting in an oxygen content of 1.19%. Although neither Rentech's nor Mossgas's submissions identify the specific oxygenated compounds, other Mossgas papers identify the Mosstanol alcohols as C_3 and C_4 alcohols.

EPA's Fuel/Fuel Additive Registration Regulations (40 CFR Part 79) address health and welfare effects of fuels and additives marketed in the U.S. by requiring submission of certain types of data (Tier 1 and Tier 2 data) within the registration process. This program, however, treats oxygenated diesel fuels with up to 1% oxygen content as "baseline" diesel. It also exempts producers and importers with less than $50 million in annual sales at the time they register from submitting such data. While these exceptions may be appropriate for EPA's purposes, they are not necessarily compatible with a finding of "substantial environmental benefits." While DOE accepts that some *de minimis* oxygenate content should be allowed in FTD to avoid excess costs of removing such compounds, the 1% oxygen content threshold, translating in up to 10% content of some oxygenated compounds, could be considered too high. DOE believes that a limit of 0.25% of oxygenated compounds for which Tier 1 and Tier 2 data have not been submitted would be more appropriate[49]. Oxygenated compounds for which Tier 1 and Tier 2 data have been submitted could be allowed in any volumes allowed by EPA unless DOE adopts a subsequent regulation to the contrary. If EPA decides based on Tier 1 data that Tier 2 data are not required for an additive, the additive would be allowed by DOE in any quantities allowed by EPA, but mere registration under the small business provisions would not be adequate.

DOE requests comment on this approach to inclusion of oxygenated compounds in FTD fuels or suggestions for any alternative approaches.

V. ADDITIVE ISSUES

All hydrocarbon fuels employ additives for purposes of meeting fuel specification requirements and to assure that the fuel does not degrade during storage. Diesel fuels typically employ several types of additives including biocides to prevent growth of bacteria and fungi during storage, stability improvers to prevent the oxidation of fuel over time, cold-flow improvers to prevent blockage of fuel lines and filters at low temperatures, detergents to prevent deposits and minimize nozzle coking, corrosion inhibitors, antistatics, antifoamants, lubricity enhancers, and others. Some diesel fuels will incorporate cetane improvers to meet specifications or for emissions purposes.

With respect to the need for additives, FTD fuels typically have properties that are superior to conventional diesel fuels in some areas, and worse in others. It is anticipated that retailers of FTD will apply commonly available additives as needed to meet specifications and engine performance requirements. ***DOE is seeking comment on whether any characteristics of FTD are sufficiently unique to justify inclusion of specific additives to assure that its inherent environmental benefits are not degraded or negated due to negative impacts on engine components or emission control systems.***

---

[49] The 0.25% threshold is consistent with the threshold for oxygenated compounds in EPA's interpretive rule on fuels and additives deemed "substantially similar" to certification gasoline. 56 *Fed. Reg.* 5352, 5356, Feb. 11, 1991. To date, EPA has not adopted such an interpretive rule for diesel fuels.

VI. RELATIONSHIP OF POTENTIAL FTD DESIGNATION TO EPAct IMPLEMENTATION

If DOE were to designate some or all FTD as EPAct alternative fuel, questions would arise about the impact on programs under other sections of EPAct, especially current fleet programs. DOE believes that such impacts will be very limited. Under EPAct, fleets are required to acquire alternative fuel vehicles (AFVs). No currently manufactured AFVs are designed specifically for use with FTD; furthermore, conventional diesel vehicles using FTD do not qualify as AFVs for EPAct compliance, as detailed below. The impacts of designating FTD as an EPAct alternative fuel are, therefore, limited to the use of FTD in qualified AFVs (e.g. dual-fuel CNG/diesel vehicles) and the inclusion of FTD in EPAct analytical activities.

Under a sec. 301(2) designation, FTD use could be counted toward the alternative and replacement fuel goals of sec. 502(b) and could be included in various other EPAct analytical activities such as those of sec. 502, sec. 503, sec. 504, and sec. 509. Use of FTD from natural gas also appears to count toward the requirement of Executive Order 13149 (65 *Fed. Reg.* 24607, April 26, 2000) that all federal fleets reduce their use of petroleum by 20% by FY 2005 compared to FY 1999 levels. Beyond these activities, essentially all of the programs called for by EPAct Titles III and V relate to acquisition of alternative fuel vehicles (AFVs) and, for fuel provider fleets, to the use of alternative fuels in AFVs (if the alternative fuels are available in the areas where the AFVs are operated). The following paragraphs address some apparent confusion regarding these AFV programs, clarifying that fleet use of FTD (or intent to use FTD) in conventional diesel vehicles does not meet the AFV acquisition requirements of EPAct Title III and Title V; nor does it meet the requirements for alternative fuel providers and federal fleets to use alternative fuels in their AFVs.

Use of FTD in Alternative Fuel Vehicles

FTD fuels could be used in AFVs that are countable for EPAct fleet acquisition credits. For example, some AFVs are designed to run on both compressed natural gas and diesel (some of which can run on diesel fuel alone). Alternative fuel providers covered by sec. 501 are required both to acquire AFVs and to operate the vehicles on alternative fuel except when operating in an area where the alternative fuel is not available. These covered persons could satisfy their AFV acquisition requirements by acquiring dual fuel AFVs and satisfy their requirements for using alternative fuel by using FTD (if designated) in these AFVs. Federal government fleets covered by sec. 303, while not required by EPAct to use alternative fuel, are subject to Executive Order 13149, which calls for a majority of the fuel used in the AFVs acquired by those fleets to be alternative fuel by the end of FY 2005. If designated, FTD used in these dual fuel AFVs could count toward the goal of majority alternative fuel use. FTD could also be used to reduce federal fleets' petroleum consumption as called for in E.O. 13149.

To date, no AFVs have been specifically produced for FTD use, in part because FTD is said to be fully compatible with conventional diesel engines and vehicles. Some research has been performed, however, relating to possible redesign of diesel engines to take advantage of FTD fuel properties.[50] If manufacturers made design modifications specifically for FTD use, DOE would, upon request, determine whether such modifications would classify those vehicle models as AFVs.

---

[50] "Development of Truck Engine Technologies for Use with Fischer-Tropsch Fuels," SAE Technical Paper Series, 2001-01-352, Mike P. May, Keith Vertin, Shouxian Ren, Xinqun Gui, Ian Myburgh, and Paul Schaberg, reprinted from *SI and Diesel Engine Performance and Fuel Effects* (SP-1645), SAE International, Warrendale PA., 2001.

Use of FTD in Conventional Vehicles

Because FTD can be used in conventional diesel vehicles without modification, that is expected to be its main use. Such use of FTD does not meet any of the regulatory requirements relating to AFV acquisition or use of alternative fuels in AFVs under sec. 303 (federal fleets), sec. 501 (alternative fuel providers), or sec. 507(o) (state fleets).

Conventional vehicles cannot become AFVs for purposes of EPAct compliance based on use of a particular fuel some or all of the time. Vehicles are not classified as AFVs based on the fleet operator's intent to use certain fuels at the time of vehicle acquisition, which DOE would have no way of determining, but on the design of the vehicle models themselves. The EPAct fleet programs are mainly requirements for acquisition of new AFVs. The point of compliance is the acquisition of the vehicles. Each fleet's AFV requirements are determined vehicle model-year-by- vehicle model-year (as percentages of total acquisitions), in accordance with the program's structure by vehicle model and acquisition.

The following paragraphs show that allowing use of FTD in conventional vehicles to meet EPAct fleet AFV compliance would violate both the letter and the intent of EPAct and could damage fleet AFV programs.

Statutory Language

Sec. 301 defines "*alternative fueled vehicles*" (sec. 301(3)) *and "comparable conventionally fueled vehicles*" (sec. 301(4)) to be mutually exclusive. Conventional diesel vehicles do not fall within the definition of "*alternative fueled vehicle*" but rather *of "comparable conventionally fueled vehicle*." Sec. 301(4) defines "*comparable conventionally fueled vehicle*" as including a motor vehicle which is, "(B*) powered by an internal combustion engine that utilizes gasoline or diesel fuel as its fuel source …*" The definition also states that such vehicle must be "(A) *commercially available at the time the comparability of the vehicle is being assessed*," making clear that the classifications (including utilization of gasoline or diesel) apply based on vehicle model, not based on operation in-use.

Sec. 301(3) defines "*alternative fueled vehicle*" as including ***only*** "*dedicated vehicles*" and *"dual fueled vehicles*." Conventional diesel vehicles do not fall into either category as the words are normally understood and Congress intended. These definitions include "*dedicated automobiles*" *and "dual fueled automobiles*" as defined for CAFE credits[51] – which relate to each manufacturer's production for each model year. Under EPAct and CAFE, every vehicle model is either an AFV or a conventional fuel vehicle from the time of its manufacture (CAFE) and its acquisition (EPAct); what fuels are used in what circumstances and for what periods of time does not affect the classification of the model as AFV vs. conventional.

The sec. 301(6) definition of "*dedicated vehicle*" uses the language "*that operates solely on alternative fuel*" in reference to both automobiles and other vehicles. Sec. 301(8) defines "*dual fueled vehicle*" with

[51] Sec. 301(6)(A) refers to "dedicated automobile" and sec. 301(8)(A) refers to "dual fueled automobile" by incorporating the definitions in sec. 513(h)(1)(C) and (D) of the Motor Vehicle Information and Cost Savings Act, which has been reenacted without amendment and recodified as 49 USC Chapter 329 (definitions at sec. 32901). Therefore, while the MVICSA section numbers no longer apply, the provisions do.

the language "... *is capable of operating on alternative fuel and is capable of operating on gasoline or diesel*." These definitions clearly refer to vehicles that are designed and built to run solely on alternative fuel or built to be capable of operating on both alternative fuel and gasoline or diesel, as is already reflected in DOE's regulation defining "*Flexible Fuel Vehicle*" at 10 CFR 490.2: "*any motor vehicle engineered and designed to be operated on any mixture of two or more different fuels*."[52] (Other types of dual fueled vehicles are those capable of running on either of two fuels but not mixtures of the two, hence not pertinent to FTD use in conventional vehicles.)[53]

An alternative interpretation of the EPAct definitions could be that once FTD were designated, conventional diesel vehicles could be seen as dual fueled vehicles because they would be capable of operating on an alternative fuel and on diesel fuel. Under that interpretation, if FTD is designated, all diesel vehicles would be "*dual fueled vehicles*," whether or not they ever use FTD, because they are capable of using it. If the fleet fueled these diesel vehicles solely with FTD, however, under this interpretation they would also *be "dedicated vehicles*" ("*a vehicle that operates solely on an alternative fuel*"). DOE does not find this alternative interpretation persuasive but believes sec. 301 intended the definitions of "*dedicated vehicle*", "*dual fueled vehicle*," *and "comparable conventionally fueled vehicle*" to be mutually exclusive based on the design and manufacture of the vehicle.

Under the alternative interpretation of the definitions, fleets could count all their acquisitions of diesel vehicles – there is no requirement (other than alternative fuel providers) that the alternative fuel be used and certainly no change in classification of the vehicle based on how much of what fuel it is using at any time. Congress's intent was not merely to shift acquisitions from gasoline vehicles to diesel vehicles. Such an interpretation would defeat the statute's purpose and is rejected by DOE.

DOE has interpreted these terms strictly in its regulations. For example, fleets that physically convert their existing vehicles to even dedicated alternative fuel use are not allowed to count such conversions toward their AFV acquisition requirements. Only conversions of new vehicles and OEM-produced AFV acquisitions new to the fleet are counted. It would be inconsistent with this regulation and inequitable to count vehicles involving no conversion, no modification, no special design, and which might well use conventional diesel fuel at will (or based on the availability of FTD) as AFVs.

Intent of the EPAct AFV Acquisition Requirements

In Title III and Title V of EPAct, Congress singled out certain centrally fueled fleets for AFV acquisition requirements. This was justified on the premise that some alternative fuels were believed inherently competitive with gasoline or diesel fuel but faced a "chicken-and-egg" problem impairing them from penetrating the market. It was believed that auto makers would not introduce AFV models unless assured that fuel would be available, while fuel providers would not establish infrastructure to make alternative fuels available as needed for motoring use unless assured that a critical mass of AFVs would be in use. AFV requirements for centrally fueled fleets were seen as a possible way of breaking this impasse. Such fleets would not be dependent on widespread networks of refueling infrastructure for the alternative fuels but could proceed based on central refueling sites (whether their own or at commercial stations). AFV

---

[52] This interpretation is equivalent to EPA's interpretation of the terms "*Dual Fuel Vehicle*" and "*Flexible Fuel Vehicle*" at 40 CFR § 88-102.94: "*any motor vehicle ... engineered and designed to be operated on ...*"

[53] All of the various definitions referred to herein, as well as the definition of *"motor vehicle*" incorporated by EPAct from § 216 of the Clean Air Act, can be found also at DOE's Alternative Fuel Transportation regulation, 10 CFR § 490.2.

acquisition by such fleets could provide the necessary economies of scale to induce auto makers to manufacture AFVs in an adequate range of models for various needs. This could provide the nucleus for AFVs and alternative fuels to spread into broader use.

The EPAct fleet AFV requirements were intended to level the playing field for alternative fuels that faced the barriers of needing special vehicles and special or separate infrastructure. Alternative fuels, as defined by EPAct, would compete amongst each other within this very limited segment of the fuel market, estimated by DOE as only representing less than 0.2% of total highway fuel use, even before accounting for exemptions, noncompliance, and use of conventional fuels in dual fuel vehicles. Alternative fuel providers, technology developers, and AFV suppliers have invested hundreds of millions of dollars in efforts to penetrate these markets and in furtherance of the intent of EPAct.

FTD does not face the "chicken-and-egg" or level playing field problems in the broad fuel market as do the fuels requiring special vehicles and special or separate infrastructure. Thus, there is no obvious rationale for favoring its use by centrally fueled fleets and no reason to believe that its use by such fleets would provide it any foothold to the broader market. To the contrary, allowing FTD use in conventional vehicles within the EPAct fleets would seem to undo the leveling of the playing field and give it a specially advantaged position among the designated alternative fuels, as it would not require special vehicles or infrastructure. It could render useless the hundreds of millions of dollars invested by the alternative fuel stakeholders in accordance with the intent of the program. FTD for use in conventional vehicles faces a level playing field in the other 99.8% of the fuel market. There is no obvious justification for giving it a favored position within the less than 0.2% of the market reserved for fuels that must be used in AFVs and incur costs of new infrastructure development. DOE previously received a petition from the National Biodiesel Board (NBB) to designate 20% biodiesel blends (B20) for use in conventional diesel vehicles as alternative fuels under sec. 301(2). DOE did not grant that petition, in part due to concerns over use of diesel vehicles to meet the AFV acquisition requirements. NBB then asked Congress to add B20 to the sec. 301(2) list of alternative fuels. Congress also declined to do this, adopting instead a special statutory provision allowing limited use of B20 for partial EPAct compliance. Congress could have made that provision available for other fuels used in conventional vehicles or given DOE authority to extend it to other fuels (such as FTD). Instead Congress limited the provision strictly to biodiesel, thus precluding DOE from extending it to other fuels. Moreover, the various limitations Congress placed on such EPAct biodiesel use are clearly intended to protect the programs for fleet AFVs from being substantially undermined by the biodiesel/conventional vehicle option. Any move by DOE to expand use of conventional vehicles in the fleet AFV programs, let alone to extend it to fuels other than biodiesel, would clearly violate DOE's authority and the Congressional intent.

VII. FY 2001 APPROPRIATIONS ACT PROVISION

The Consolidated Appropriations Act, 2001 (Public Law 106-554, 1(a)(4)) contained the following provision:

> *Sec. 122. GAS TO LIQUIDS. Section 301(2) of the Energy Policy Act of 1992 (Public Law 102-486); 42 U.S.C. 13211(2)) is amended by inserting "including liquid fuels domestically produced from natural gas" after "natural gas".*

According to this provision, all liquid fuels produced domestically from natural gas would be classified as natural gas under sec. 301(2) of EPAct and treated as alternative fuels. This would include all domestically produced FTD, as well as methanol, and any number of other possible fuels made from natural gas. It could include glyme and diglyme, which have been identified as having toxic emissions.[54] It would include all FTD and FT/COD fuels, even those that do not meet fuel parameter specifications for substantial environmental benefits that might be applied to a designation by DOE under sec. 301(2). It would include FTD produced in plants at the extreme end of the range identified by Argonne National Laboratory for greenhouse gas emissions (possibly as great as 27% increase in GHGs) and for energy inefficiency (up to 70% greater energy use per mile).[55]

Problems with Interpretation and Implementation of the Appropriations Act Language

The Appropriations Act language raises questions as well as problems for DOE in its compliance programs. The sec. 122 language seems to require only that the liquid fuel be produced domestically, irrespective of the source of the gas. Sec. 301(7) of EPAct, however, defines "*domestic*" to mean "*derived from resources within …*," apparently referring to the source of the gas.

Moreover, the sec. 301(7) definition of "*domestic*" includes materials "*from resources within a Nation with which there is in effect a free trade agreement requiring national treatment for trade.*" In fact, the "national treatment" clauses of the free trade agreements simply incorporate Article III of the General Agreement on Tariffs and Trade, which applies to almost all U.S. trading partners.[56]

For reasons described in Section III, only a very small volume of FTD is expected to be produced either in the United States or from U.S. gas resources. Any FTD meeting the sec. 301(7) definition of "domestic" based on full free trade agreements would be from Mexico or Canada. These nations, however, may also be unlikely sources of FTD production; Canada's gas reserve/production ratios are relatively low and production costs high, while Mexico is currently a net importer of gas from the U.S.

For EPAct compliance purposes, it would be extremely difficult, if not impossible, for DOE or fleets to distinguish FTD produced domestically from that produced abroad for purposes of EPAct compliance. DOE would have to rely on paperwork accompanying shipments of FTD at each stage from producer to EPAct covered fleet to establish domestic origin. This would put considerable burdens on DOE, outstripping DOE program resources, and participating fleets.

Application of Trade Treaties and U.S. Trade Laws

Paragraph 4 of Article III of the General Agreement on Tariffs and Trade (GATT) provides that:

> "*The products of the territory of any contracting party imported into the territory of any other contracting party shall be accorded treatment no less favorable than that accorded to like products of national origin in respect of all laws, regulations and requirements affecting their internal sale, offering for sale, purchase, transportation, distribution or use. …* "

---

[54] "Assessment of Criteria Pollutant Emissions …,"Alleman et. al., p. 15 and sources cited therein. Specifically, the emissions are believed to have teratogenic effects.

[55] "Assessment of Well-to-Wheel …," Wang, Docket No. EE-RM-02-200-1B, Table 4, p. 12.

[56] See, e.g. Article 301 ("National Treatment") of the North American Free Trade Agreement.

Paragraph 1 of Article III of the GATT also provides:

> "*The contracting parties recognize that internal taxes and other internal charges, and laws, regulations and requirements affecting the internal sale, offering for sale, purchase, transportation, distribution or use of products ... should not be applied to imported or domestic products so as to afford protection to domestic production.*"

Both of the nations where FTD plants currently exist and all ten of the additional nations for which FTD projects have been announced are members of the World Trade Organization (WTO), hence contracting parties to the GATT. Thus, the United States, as a WTO member and contracting party, has firm treaty commitments not to adopt laws or regulations favoring domestic production over that of these nations.[57] The Appropriations Act language could be seen as potentially violating these treaty commitments.

The possible violations of the GATT and WTO obligations could be avoided if all GTL, both foreign and domestic, were to be treated as EPAct alternative fuels. That does not appear to be the intent of the Appropriations Act provision, however, notwithstanding the confusion created by the conflict between its language and the sec. 301(7) definition of "*domestic*." DOE's authority to expand the designations of alternative fuels under sec. 301(2) is proscribed by **specific** criteria, which do not allow for a blanket designation of GTL fuels as some GTL fuels would not meet those criteria. The analyses performed within this rulemaking, including this discussion paper and the NREL analysis of criteria pollutant impacts, do not support such a blanket designation of GTL as meeting the sec. 301(2) criteria.

DOE believes that the Administration has a duty to make Congress aware of any apparent conflict between U.S. law and U.S. obligations under international law and to recommend amendment or repeal of any statute found to be inconsistent with U.S. obligations under international law. DOE has consulted with the Office of the United States Trade Representative and believes that it has appropriately initiated this process. There is an apparent conflict between the Appropriations Act and section 301(7), as well as the problems in interpreting and implementing the statute, most importantly the inclusion within the Appropriations Act provision of undesirable forms of GTL, including GTL with negative environmental impacts.

Until such time as Congress acts to repeal the Appropriations Act language, however, DOE believes that it is bound by that language. Accordingly, all GTL produced domestically from domestic natural gas will be treated as EPACT alternative fuel irrespective of whether it meets the fuel and process specifications ultimately adopted in the rulemaking. This will include GTL made in Canada, Mexico, Israel, and Jordan. The burden of proof will be on the parties using the GTL for EPACT compliance to show its domestic origin with complete chain of custody documents. In the event that any GTL is produced in the U.S. or these four countries from natural gas or syncrude or reactor streams imported to the U.S. for final refining, which DOE considers unlikely, DOE will consider the merits and make determinations at that time.

---

[57] In addition, the United States and some of the countries where FTD projects are being considered are signatories to the Agreement on Government Procurement within the framework of the GATT, which pledges parties to provide "*National Treatment and Non-Discrimination*" (Article II) to other parties to the agreement with regard to government procurement. This would apply to the Federal fleet program and particularly to the alternative fuel use goals of Executive Order 13149.

If DOE does adopt a regulation designating (non-domestic) FTD as alternative fuel under sec. 301(2), DOE is likely to draft the language of such a rule so that, in the event that Congress does act to repeal the Appropriations Act language, DOE's rule will apply as it stands to both domestic and foreign FTD, defining appropriate parameters that will assure that the sec. 301(2) criteria are met for both.

VIII. POTENTIAL APPLICATION OF A SEC. 301(2) DESIGNATION OF FTD TO THE PETITIONS RECEIVED BY DOE

As noted above, DOE has received petitions to designate certain FTD fuels from Rentech, Inc., Mossgas, (Pty) Limited., and Syntroleum Corp. Mossgas alone among the three petitioners has existing commercial production of diesel fuels (as well as gasoline and kerosene). Mossgas has petitioned for designation of three specific fuel blends based on its existing plant production and has included fuel parameter specifications for each.

Rentech, Inc. petitioned alternatively for designation in terms of

> "Rentech's clean-burning, natural gas derived Fischer-Tropsch (F-T) Diesel Fuel" (cover letter, p. 1);
> "Rentech, Inc.'s clean-burning Diesel Fuel produced by its Fischer-Tropsch process from natural gas or coal" (petition cover page); and
> "the Fischer-Tropsch clean diesel fuel produced by Rentech, Inc.'s proprietary and patented Fischer-Tropsch process" (petition, p. 1).

In a supplemental submission, however, Rentech clarified that it believes the only logical way of designating FTD fuels is to do so generically, in terms of fuel parameter limits, and proposed such a set of specifications.

Syntroleum petitioned for designation of "S-2," a trade name it uses to refer to FTD made using some of Syntroleum's proprietary technologies. Syntroleum uses the term S-2 interchangeably to refer to FTD fuel and to a production process or processes. Although it describes the production and points out various elements it considers proprietary, it never clearly defines either the fuel or the process so as to distinguish them for regulatory purposes. For the most part, the process descriptions it has submitted describe FT processes generically, identifying as proprietary technologies only an autothermal reforming technology for synthesis gas generation and use of "one of several proprietary catalysts." A process flow diagram attached to the petition shows a generic FT process with the exception of showing nitrogen accompanying the synthesis gas, which is not typical for FT processes though it is not necessarily unique to Syntroleum. Syntroleum proposed no binding fuel or process parameter limits but only noted certain fuel specifications which it considers "typical" of "S-2."

DOE believes that designation of FTD fuels in terms of proprietary processes would neither be proper nor assure that the criteria of sec. 301(2) would be met. Emissions impacts of FTD fuels are determined by fuel properties. Apart from the distinction between Mossgas's FT-COD fuel and typical FTD fuels, such properties seem to be determined more by plant-specific factors, operating conditions, and post-synthesis refining than by proprietary technologies. The same seems to apply to plant emissions, such as greenhouse gases, and to plant efficiencies. Although proprietary processes may play more of a role in the latter regard, information available to date is inadequate to draw any regulatory conclusions regarding the sec. 301(2) criteria for processes based merely on use of Syntroleum or Rentech technologies.

Any DOE designation of FTD fuels under sec. 301(2) is likely to be made in terms of fuel and process specifications that would assure that the sec. 301(2) criteria are met. As described in the sections on environmental benefits, fuel specifications are likely to include maximum aromatics, minimum cetane number, maximum sulfur content, and possibly others. A designation would also require conformity to ASTM D-975-02 and to all applicable federal and state requirements. Process parameters could include limits on greenhouse gas emissions per unit of output and efficiency specifications to assure energy security benefits. ***DOE is not here proposing specific levels for these parameters but requesting comment on what levels should be set.*** DOE believes that the production technologies associated with each of the three petitioners are sufficiently flexible to produce fuels conforming to whatever parameter limits are ultimately adopted. In particular, the FTD fuel parameters proposed by Rentech and those identified by Syntroleum as "typical" of "S-2" are likely to fall within the designation, with the possible exception of the oxygen specification of 1 percent, from unidentified oxygenates, proposed by Rentech. The three specific FT/COD fuel formulations requested for designation by Mossgas fall in between the other FTD fuels and conventional diesel with regard to the key parameters. These fuels might or might not fall within whatever specifications DOE ultimately adopts through the rulemaking process. Whatever process parameter limits DOE ultimately adopts are likely to allow for some but not all potential process variations using the petitioners' process technologies.